Extraordinary grating-coupled microwave transmission through a subwavelength annular aperture

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We studied grating-coupling phenomena between surface plasmons and electromagnetic waves in the microwave spectrum using two-dimensional metallic gratings. We present experimental and theoretical results of enhanced microwave transmission though a subwavelength circular aperture with metallic gratings around the surface plasmon resonance frequency. This is followed by transmission studies through circular annular apertures and circular annular apertures surrounded by periodic metallic gratings. We demonstrated that 145 fold enhancement factor could be obtained with a subwavelength circular annular aperture surrounded by periodic metallic gratings. Our results showed that high transmission from a circular annular aperture with gratings was assisted by the guided mode of the coaxial waveguide and coupling to the surface plasmons. Furthermore, we showed that transmitted EM waves emerge from the aperture as a beam with a small angular divergence. The HPBW (half power beam width) of the transmitted beam through circular annular aperture surrounded by gratings was 6^{o}. The experimental results agreed well with theoretical simulations.